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(54) Coated paper, cardboard or the like and method as well as apparatus for the production thereof

(57) The invention relates to a paper, cardboard or the like, which coated in at least two stages. At least one side is provided with a double coating. The product is characterized in that 85 % of the particles in the covering material of a first-stage coating paste are such that they fulfil a condition L/h higher than 10. The invention relates also to a method of producing a paper, cardboard or the like, coated in at least two stages. The method is mainly characterized in that, between the coating stages, a web (1) to be coated is supported by means of a single element (2) travelling along with said web of paper. The invention relates also to an apparatus for producing a paper, cardboard or the like. This apparatus is characterized by comprising a web-supporting element (2), which travels along with the web for carrying the web in a supported fashion between coating stages (3, 4). The element is e.g. a cylinder installed to be rotatable around its longitudinal axis, the outer periphery of said cylinder touching at least two spreading units (3, 4), mounted at a peripheral distance from each other. A heater (5) can be fitted between said spreading units.

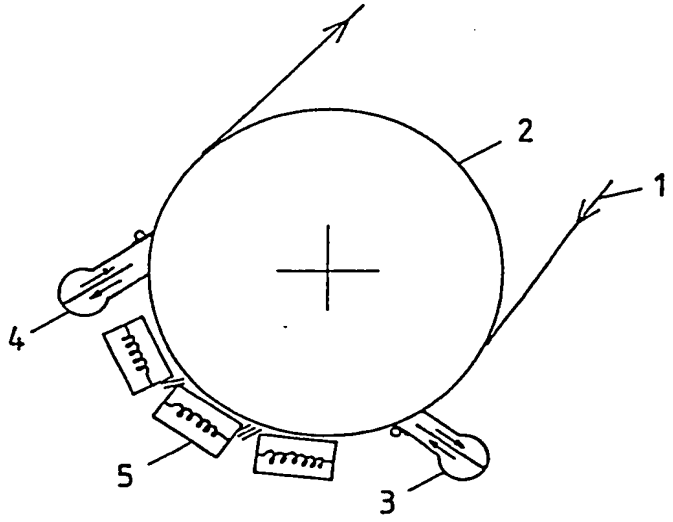

Fig 1

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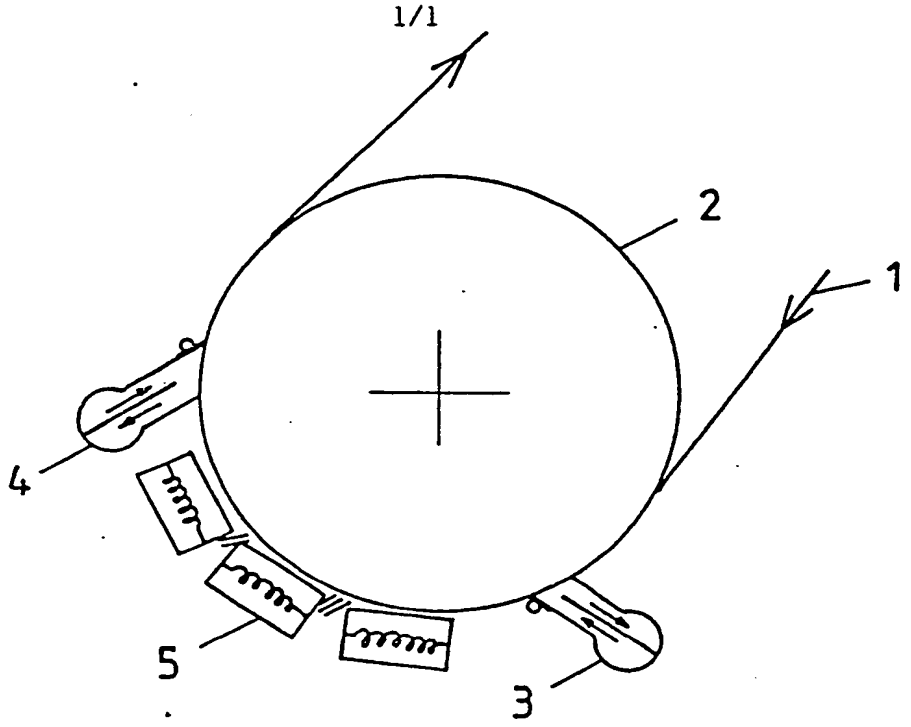


Fig 1

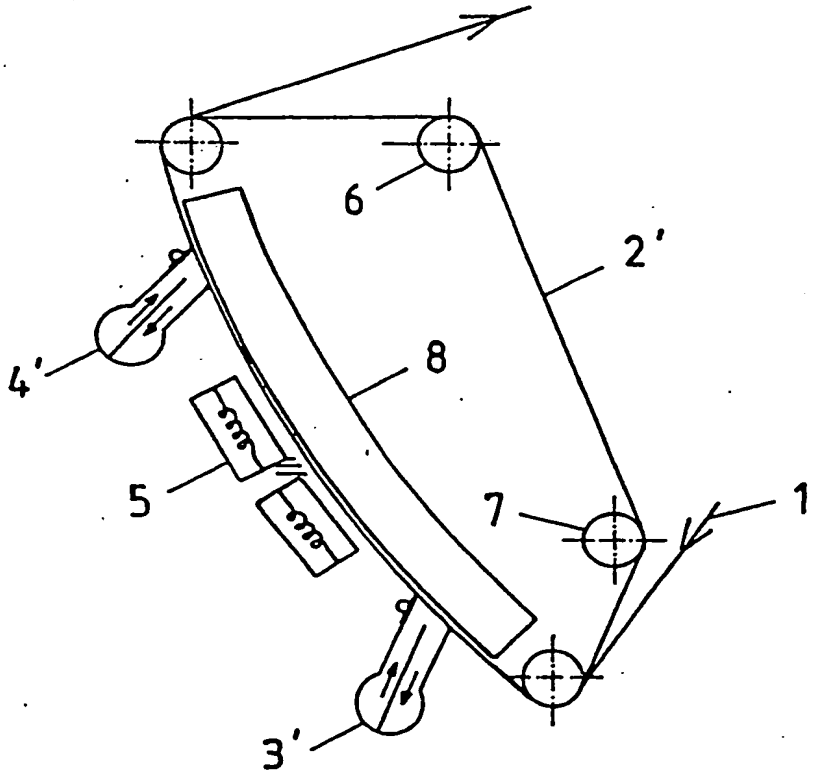


Fig 2

SPECIFICATION

Coated paper, cardboard or the like and method as well as apparatus for the production thereof

Coated paper, cardboard or the like and method as well as apparatus for the production thereof.

The present invention relates to a coated paper, cardboard or the like, which is coated on one or both sides so that at least one side is provided with at least a double coating.

A printing paper used for high-quality printing purposes is generally coated with a thin layer of coating paste during the course of a paper making process. This can be effected either as an individual operation as so-called off-machine coating or as an operation associated with the manufacture of base paper as so-called on-machine coating. In either case, a single layer of coating paste is separately, or sometimes simultaneously, applied to both sides of paper.

Several different types and variations of equipment are known to be suitable for the application of a layer of coating paste. The coating paste can be applied to the surface of paper e.g. by means of a set of rollers or by extrusion. On the other hand, smoothing and scraping the layer so as to thin it can be effected by using e.g. blade or rod scraping or a roller nip.

Blade coating provides a very smooth layer of coating behind the blade. The blade is used to fill the irregularities in paper and scrape off the excess material. After the blade, due to dewatering, the coating layer nevertheless shrinks and sets in the surface irregularities. At the same time, this leads to the exposure of fibre surfaces remaining uncoated after the action of a scraper. Thus, even though such single coated paper is quite satisfactory for several purposes, its quality, especially its applicability to more demanding printing jobs can be improved by taking measures to improve the smoothness, glossiness and uniformity of ink absorbency in paper.

When coating certain subtypes of a so-called fine paper, the coating has been applied to paper in two stages, i.e. a so-called double-coating has been employed. The paper is first coated by using e.g. a size press or a similar device, often also by blade-coating or by some intermediate means (so-called pigmentation), sometimes effected as an on-machine operation. This is followed by coatig the same side again by blade-coating. The latter is effected in practice as a separate off-machine operation. The top-quality products are coated twice on both sides after surface sizing.

Information is also available about the advantages of double-coating for certain subtypes of thin printing paper, so-called LWC-grade. In the LWC-grade, the amount of a single coating layer is e.g. 10 g/m^2. The thicker, so-called NWC-grades, which contain mechanical pulp, are already produced with double-coating in commercial scale. In this case, the amounts of coatings are higher than what could be used in LWC-grades.

However, even with coating amounts of 10-12 g/m^2, a double-coating gives a better result than a single coating with the same amount of coating material. The superiority of double-coating is evidenced in smoothness measurements and clearly in the printing impression as a smoother and glossier, more photographic printing result. Nowadays, the pigment material of a coating paste in the first coating stage is generally carbonate, whose L/h-ratio (to be explained later) is circa 2. Thus, the covering power at the first stage is poor, leading to the total demand of large amounts of coating material.

In the present-day double-coating methods, attention has not been paid to the significance of coating steps and particularly the first coating step for a coated product or for the manufacturing process and structure of the equipment. The most important aspect to be considered in a coating process is naturally the properties, such as smoothness, glossiness and ink absorbency of a final product, i.e. coated paper, cardboard or the like. Now it has been surprisingly discovered that the properties of a coated product can be achieved with lower total amounts of coatng material if at least 85 % of the particles in the covering material of a first-stage coating paste of a coated product (paper, cardboard or the like) are such that they fulfil a condition L/h higher than 10. The ratio L/h relates to a ratio between the largest and smallest dimension of the particles. Furthermore, the particle size distribution must be such that at least seventy percent of all particles have an equivalent diameter less than 5 um. An equivalent diameter refers to the diameter of such a sphere which has sedimentation characteristics corresponding to those of a certain shape particle. A test for determining the equivalent diameter of a covering material can be carried out by using e.g. a Sedigraph 5000 test, effected by means of a Micromeritics device. The use of such covering material results in a coating paste with a very effective covering power, whereby it is possible to produce a paper, cardboard or the like with certain surface and printing characteristics by using a smaller total amount of coating material. This effect is achieved in a manner that the particle size distribution of a covering material small and the particles have a flat configuration, as indicated by the ratio L/h. Such a covering material can also be hydrophobic in most cases, so its dewatering is quick. This aspect offers several process-technical advantages. The coating paste may also contain added auxiliary pigments, whose L/h-ratio is very low. Thus, these auxiliary pigments do not create covering power but certain other properties.

The amount of a first-stage coating paste of the total amount of coating material is less than the half. The total amount of coating is 18 g/m^2 at the most. A paper with good properties can be achieved even with the amount of coating less than 15 g/m^2 by using a first-stage coating paste of the invention. Typically, the amount of a first-stage coating paste is appr. 44% of the total amount of coating material and at least 2 g/m^2. The covering material can preferably comprise e.g. such bolus alba or talc, whose L/h-ratio is typically 20-40, or a mixture thereof. The water retention (dewatering) of a first-stage coating paste is in the order of 10 s ... 80

s, preferably 20 s ... 40 s. Thus, water retention is determined by "S.D. Warren-test", TAPPI, Feb. 1958, vol. 41, No. 2.

The invention relates also to a method of coating paper, cardboard or the like in at least two stages at least on the same side of a web, the web to be coated being passed from one coating stage to the other.

As for the technical aspect of the method, a double-coating with available technology on both sides of a web requires the building of four coating heads, fitted with one spreading unit, either in connection with a paper-making machine or on a separate coating machine or partially on both. The present-day equipment is constructed in a manner that a web to be coated is passed through sets of rollers or the like auxiliary means fitted stationary and rotating between the coating heads. This use of sets of rollers requires strength of the web, so the web moisture is essential regarding the method and operation of the equipment. Thus, after each spreading unit, the entire web must be dried to a dry matter content of 96-97%. This means that the intermediate drying operations increase operating costs considerably. In addition, a coating effected by means of e.g. four coating heads (two-stage coating on both sides of a web) reduces substantially the efficiency of a production line, requires more supervising staff and, as susceptibility to faults increases, leads to more reject compared to a method whereby a similar coating could be effected with a reduced number of coating heads.

The present-day coating methods are further characterized in that the water retention of a pigment paste is as high as possible.

An object of a method according to the invention is to provide an improvement for the drawbacks appearing in the present-day coating technology. The method provides a considerable freedom of choice as for the properties of a first coating stage pigment paste, since the strength characteristics of a web to be coated are not critical in view of carrying out the method successfully. Hence, the covering power and dewatering properties of a pigment paste can always be selected to be optimal. In addition, the method affords an apparatus construction, wherein a single coating head is capable of performing all coating operations as it can be provided with at leat two spreading units.

In order to achieve this objective, a method of the invention is essentially characterized in that between the coating operations a web is supported by means of an element moving along with the web. Thus, the moisture of a web can be high between the coating operations or stages, since the web is not exposed to any major stresses. Thus, for example, the coating paste for a first coating operation can be selected in a manner that its deatering is quick. This way the web can receive moisture from the first coating paste so as to reach more quickly the solidifying point of a first-stage coating paste. The solidifying point refers to that dry matter content of a coating past at which individual pigment particles are no longer capable of moving relative to each other but some movement may still occur in the binder component. In other words, the method makes it possible to arrange the conditions after the first coating stage in a manner that the dry matter content of a coating paste on the surface of a web quickly reaches a determined level of 78-85%, while it is typically 55-60% during the spreading of a coating paste. At least some of this demoistening of a coating paste can be effected by selecting a coating paste with a low water retention, which means that moisture is quickly absorbed from a coating paste into a web to be coated. This is achieved by supporting the web according to the invention with a consequence that there are no stages between the coating stages or operations that would require dry strength of paper, cardboard or the like. It is obvious that, according to the method, the dry matter content of a web can be increased between the coating stages also by removing liquid by evaporation to atmosphere. This is useful e.g. if the machine speed is high or compact equipment is desired.

As can be appreciated from the above, an essential subject matter regarding the invention is the selection of the properties of a first-stage coating paste so as to achieve the desired properties for a final product, i.e. for coated paper, cardboard or the like with a smaller total amount of coating material. Thus, the first coating stage or operation is essential as for the properties of a product as well as for carrying out the method. As for the following, at least one spreading unit, the conditions can be freely selected within the limits of requirements set for the properties of a final product.

The measurement and adjustment of the thickness of a coating layer in such a method can also be achieved at present. Measuring can be effected e.g. by utilizing prior known X-ray fluorescence measuring technology.

The invention relates also to an apparatus for producing paper, cardboard or the like according to the invention by applying the method. The apparatus comprises two or more spreading units for coating at least one surface of a web and at least in two stages. A web of paper, cardboard or the like to be coated is passed from one coating stage to the other.

As pointed out above, a web to be coated is passed in the present-day equipment through sets of rollers or like auxiliary devices mounted stationary and rotating between coating heads which are provided with a spreading unit.

An apparatus of the invention is essentially characterized by comprising a web-supporting element moving along with the web for carrying the web in a supported manner between the coating stages.

A few preferred constructive alternatives for embodying the above-mentioned element include a cylinder, which is mounted rotatable around its own longitudinal axis and whose outer periphery touches at least two spreading units set at a peripheral distance from each other, or an endless conveyor provided with at least two spreading units spaced from each other in the longitudinal direction of said conveyor.

The invention will now be described in more detail in the floowing specification with reference made to the accompanying drawing. In the drawings, figures 1 and 2 are schematical side views of the alternative

preferred embodiments of an apparatus of the invention.

Figure 1 illustrates an assembly wherein the supporting element, which moves along with the assembly, comprises a single cylinder 2 mounted to be rotatable around its longitudinal axis. Said cylinder 2, together with spreading units 3 and 4, provides a coating head whereby the first surface of a web 1 of paper, cardboard or the like can be coated in two stages. The diameter of cylinder 2, as well as the distance between the spreading units 3 and 4 mounted on the periphery of cylinder 2, is selected in a manner that the distance between coating stages and the travelling speed of a web from the first coating stage to the second coating stage are appropriate particularly in view of obtaining suitable surface properties for the web following the first coating stage, in other words, the web transfer time from the first coating stage to the second is appropriate.

Between spreading units 3 and 4 on the outer surface of cylinder 2 can be mounted a heater 5 for promoting de-moisturizing, which can be e.g. a radiator operating within the infrared range. The shape of the heat delivery surface of such a heater can be designed to match the surface configuration of cylinder 2. The heater can be provided with ventilation ducts for a more effective drying. Furthermore, the surface of cylinder 2 can be designed so as to effectively reflect heat radiation. In the case of a metal cylinder, this can be done e.g. by polishing the cylinder surface. In addition, in order to achieve a preferred thermal equilibrium, said cylinder can be heated or cooled by using e.g. fluid circulation or air blow either from inside or outside.

Figure 2 shows a second preferred embodiment of an apparatus of the invention, designated with corresponding reference numerals and wherein the web-supporting element comprises a single endless conveyor 2', adapted to be movable on rollers or the like 6 and 7 at the same speed as a web of paper. Spreading units 3' and 4' are spaced from each other in the longitudinal direction of said conveyor. Furthermore, said conveyor 2' can be supported on the opposite side from the web by means of support plates 8 or the like.

The spreading units 3, 4 and 3', 4' can be preferably embodied by using so-called short-delay units, wherein a blade assembly carries a coating paste onto the surface of a web through a nozzle, whose front wall is formed by said presding blade. An advantage offered by a short-delay unit is a reduced wetting of paper prior to scraping, resulting in fewer interruptions. The blade pressures applied to a web are relatively negligible. In addition, washings can be effected more readily and quickly during the interruptions.

Such short-delay units are per se known as spreading devices. In the invention, it is possible and preferable to utilize one quality thereof, namely that their tendency to cause trouble is negligible even at high running speeds, which is why they are spreading units particularly suitable for the purpose of this invention. This does not exclude other spreading units, but then it is not possible to attain equally high running speeds. One application of the invention is the modernization of outdated paper-making machines. Those do not offer much space for construction, making the application of this invention very favourable. For other reasons, the speed of outdated paper-making machines is restricted to 700-800 m/min maximum. In this case, some device other than a short-delay device can be used equally well.

In addition to papers and cardboards, the scope of invention covers also e.g. various types of laminated structures, the top layer consisting of a woodpulp-based material.

The following table 1 illustrates a few coating pastes, particularly suitable as pastes for a first coating stage. The proportions are reported as parts by weight and coating pastes 1 and 2 are offset pastes and 3 is a photogravure printing paste.

TABLE 1

	1	*2*	*3*
Bolus alba	100	-	-
Talc	-	100	100
Latex (e.g. styrenebutadiene)	10,5	11	4
Water-soluble binder (e.g. carboxymethyl cellulose)	1	1	-
Lubricant	0,5	0,5	-
Dispersing agent	0,3	0,3	0,3
pH-regulator	0,02	0,02	0,02
Hardener	0,1	0,1	-
Moistener	-	0...1	0...1

The following table 2 illustrates suitable second-stage pastes (proportions in parts by weight)

TABLE 2

	Offset	*Photogravure printing*
Bolus alba	100	-
Talc	-	100
Latex A	11	-
Latex B	-	4
Water-soluble binder	1	-
Dispersing agent	0,03	0,03
Lubricant	0,5	-
Hardener	0,1	-
Moistener	-	0...1
pH-regulator	0,02	0,1

The following table 3 illustrates the properties of offset paper when the question is about LWC-base paper and the amount of a first-stage coating paste is 5 g/m^2.

TABLE 3

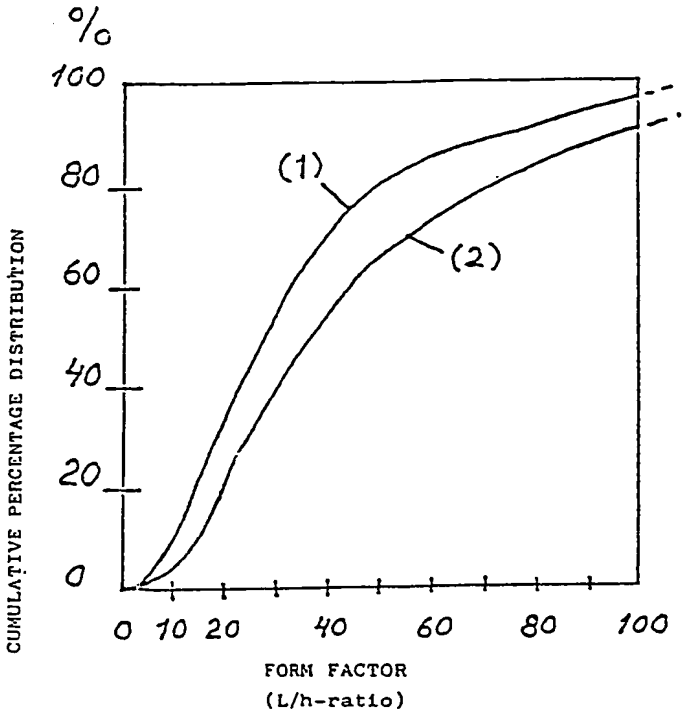
Total amount of coating	*g/m^2*	*10*	*12*
Gloss, Hunter 75°	%	60–70	63–73
Whiteness ISO	%	65–76	68–77
IGT-surface bonding strength	m/s	0,6–1,0	0,75–1,1
K & N-ink absorption	%	7–12	8–14
Bite PPS s10	um	0,6–1,2	0,4–0,8
Bite PPS s20	um	0,3–0,6	0,3–0,5

Table 4 further shows an example of the quality values of photogravure printing paper and the amount of a first-stage coating paste is 5 g/m^2.

TABLE 4

Amount of coating	*g/m^2*	*10*	*12*
Bite PPS s10	um	0,6–1,2	0,4–0,8
Bite PPS s20	um	0,3–0,6	0,3–0,5
Smoothness Fogra, 4,9 mPa	%	40–65	45–75
Heliotest	mm	60–90	70–105
Gloss, Hunter 75	%	50–70	55–80

Also enclosed is an exemplary curve about the cumulative percentage distribution of L/h-ratio for two different types of talc (Finnminerals Oy, Talc C10(1) and M(15)2.



CLAIMS

1. A coated paper, cardboard or the like, which is coated on one or both sides so that at least one side is provided with at least a double-coating, characterized in that at least 85% of the particles in the covering material of a first-stage coating paste are such that they fulfil a condition L/h higher than 10, the ratio L/h relating to a ratio between the largest and smallest dimension of the particles, and that the size distribution is such that at least seventy percent of all particles have an equivalent diameter less than 5 um.

2. A coated paper, cardboard or the like as set forth in claim 1, characterized in that the amount of a first-stage coating paste of the total amount of coating material is not more than half and that the total amount of coating material is 18 g/m^2 at most.

3. A coated paper, cardboard or the like as set forth in claim 1, characterized in that the covering material comprises bolus alba and/or talc, whose L/h-ratio is typically 20-40.

4. A coated paper, cardboard or the like as set forth in claim 1, characterized in that the water retention of a first-stage coating paste is 10s ... 80s, preferably 20s ...40s.

5. A method of coating paper, cardboard or the like at least in two stages on the same surface of a web to be coated, said web to be coated being passed from one coating stage to the other, characterized in that between the coating operations or stages said web (1, 1') is supported by means of an element (2, 2').

6. A method as set forth in claim 5, characterized in that between the coating stages, moisture is removed from the web by evaporation.

7. An apparatus for producing coated paper, cardboard or the like, said apparatus comprising two or more spreading units for coating at least the first surface of a web at least in two stages, said web to be coated being passed from one coating stage to the other, characterized in that the apparatus comprises a web-supporting element (2, 2'), moving along with the web for carrying the web in a supported manner between coating stages (3, 4; 3', 4').

8. An apparatus as set forth in claim 7, characterized in that said element is provided by a cylinder (2'), mounted to be rotatable around its own longitudinal axis and whose outer periphery touches at least two spreading units (3, 4) set at a peripheral distance from each other.

9. An apparatus as set forth in claim 7, characterized in that said element is provided by an endless conveyor (2'), provided with at least two spreading units (3', 4') spaced from each other in the longitudinal direction of said conveyor.

10. An apparatus as set forth in claim 7, characterized in that between spreading units (3, 4; 3', 4') is mounted a web-heating device (5), such as an infrared radiator, and that the surface of element (2, 2') is made reflective.

11. A method of coating paper, cardboard or the like substantially as hereinbefore described with reference to the accompanying drawings.

12. An apparatus for producing coated paper, cardboard or the like substantially as hereinbefore described with reference to the accompanying drawings.

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